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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/803,712

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Yee-Chia Yeo

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EXAMINER

RAYMOND, BRITTANY L

ART UNIT

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1795

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DELIVERY MODE

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/803,712	Applicant(s) YEO ET AL.	
	Examiner BRITTANY RAYMOND	Art Unit 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 December 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-38,40-49 and 51-75 is/are pending in the application.
- 4a) Of the above claim(s) 1-37 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 38,40-49 and 51-75 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Objections

1. Claim 53 is objected to because of the following informalities: The "y" at the end of the claim should be removed. Appropriate correction is required.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 38, 40-47, 56, 57, 59, 63-66, 72 and 74 are rejected under 35 U.S.C. 102(b) as being anticipated by Fukuda (U.S. Patent 5715039).

Fukuda discloses an immersion lithography method and apparatus comprising: placing a wafer onto a wafer support, placing a chemically amplified photoresist onto the wafer, supplying an immersion fluid of water between an optical surface and the wafer support so that the immersion fluid contacts the photoresist, and projecting a patterned beam having radiation of 193 nm onto the photoresist layer (Column 1, Lines 63-66, Column 10, lines 1-12 and Figure 15b), as recited in claims 38, 56, 57, 59, 63, 72 and 74 of the present invention. It is inherent that water has a pH of about 7, which means that it could be 6.999, making the pH less than 7, as recited in claims 38, 40-43 and 63-66 of the present invention. Also, it is known by one of ordinary skill in this art that pH is equal to $-\log [H^+]$, as shown by Brown (Chemistry: The Central Science). Thus, claims 44-47 are equal to claims 40-43, respectively, and are rejected for the same reasons.

Fukuda teaches every limitation of claims 38, 40-47, 56, 57, 59, 63-66, 72 and 74 of the present invention and thus anticipates the claims.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
 2. Ascertaining the differences between the prior art and the claims at issue.
 3. Resolving the level of ordinary skill in the pertinent art.
 4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
5. Claims 38, 40-47, 57, 59, 63-66 and 74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rostalski (U.S. Patent Publication 2003/0174408) in view of Casiday ("Water Hardness: Inorganic Reactions Experiment").

Rostalski discloses an immersion lithography method comprising: placing a photoresist layer onto a substrate, which is placed on a wafer support, filling a space between the wafer and an optical surface with a deionized water immersion fluid so that it contacts the photoresist layer, and projecting a patterned beam through the system to the substrate (Paragraphs 0042, 0051-0052), as recited in claims 38, 57, 59, 63 and 74 of the present invention.

Rostalski fails to disclose that the immersion fluid has a pH less than 7 and in the range of 2 to 7, 4 to 7, 5 to 7, and 6 to 7.

Casiday discloses that the pH of deionized water is typically found to be around 6 (Page 4, number 3), as recited in claims 38, 40-43 and 63-66 of the present invention. Also, it is known by one of ordinary skill in this art that pH is equal to $-\log [H^+]$, as shown by Brown (Chemistry: The Central Science). Thus, claims 44-47 are equal to claims 40-43, respectively, and are rejected for the same reasons.

It would have been obvious to one of ordinary skill in the art, at the time of invention by applicant, to have used deionized water with a pH less than 7, as suggested by Casiday, as the immersion fluid of Rostalski because Casiday teaches that deionized water often has pH levels in the acidic region.

6. Claims 48, 49, 67 and 68 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rostalski (U.S. Patent Publication 2003/0174408) in view of Casiday ("Water Hardness: Inorganic Reactions Experiment") as applied to claims 38, 40-47, 57, 59, 63-66 and 74 above, and further in view of French (U.S. Patent Publication 2004/0175647).

The teachings of Rostalski and Casiday have been discussed in paragraph 5 above.

Rostalski and Casiday fail to disclose that the optical surface can be silicon oxide or calcium fluoride.

French discloses that a compound lens can be made out of calcium fluoride or

hydroxyl free silica, also known as silicon dioxide, when used in an immersion lithography process (Paragraphs 0190 and 0191), as recited in claims 48, 49, 67, and 68 of the present invention. It is known by one of ordinary skill in this art that silicon dioxide and silicon oxide have similar properties.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have used silicon oxide or calcium fluoride for the optical surface, as suggested by French, in the process of Rostalski and Casiday because French teaches that this type of material does not react with the immersion liquid used and works well with the type of exposure light used in the present invention.

7. Claims 58, 60, 73 and 75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rostalski (U.S. Patent Publication 2003/0174408) in view of Casiday ("Water Hardness: Inorganic Reactions Experiment") as applied to claims 38, 40-47, 57, 59, 63-66 and 74 above, and further in view of Levinson (U.S. Patent Publication 2005/0037269).

The teachings of Rostalski and Casiday have been discussed in paragraph 5 above.

Rostalski and Casiday fail to disclose that the stage and the semiconductor are immersed in the immersion fluid.

Levinson discloses an immersion lithography apparatus comprising a stage upon which the wafer to be patterned is mounted (Paragraph 0018). Levinson discloses in Figure 1 that the wafer region is immersed in the immersion fluid, as recited in claims 58

and 73 of the present invention. It would be obvious to immerse the stage underlying the wafer in the immersion fluid since the stage is part of the wafer region, as recited in claims 60 and 75 of the present invention.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have immersed the stage and the semiconductor in the immersion fluid, as suggested by Levinson, in the process of Rostalski and Casiday because Levinson teaches that immersing the whole stage and substrate allows for the pattern to be formed properly.

8. Claims 61 and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rostalski (U.S. Patent Publication 2003/0174408) in view of Casiday ("Water Hardness: Inorganic Reactions Experiment") as applied to claims 38, 40-47, 57, 59, 63-66 and 74 above, and further in view of Hirayama (U.S. Patent Publication 2006/0154188).

The teachings of Rostalski and Casiday have been discussed in paragraph 5 above.

Rostalski and Casiday fail to disclose that the step of developing the photoresist comprises immersing the photoresist in tetramethylammonia hydroxide.

Hirayama discloses an immersion lithography method for forming resist patterns comprising: forming a photoresist film on a substrate, placing an immersion fluid on the resist film, exposing the resist film through the immersion fluid, and developing the resist film to form a pattern (Paragraphs 0179-0183), as recited in claim 61 of the present

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invention. Hirayama states that the developing solution can be tetramethylammonium hydroxide (Paragraph 0226), as recited in claim 62 of the present invention.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have immersed the photoresist in tetramethylammonium hydroxide during the development step, as suggested by Hirayama, in the process of Rostalski and Casiday because Hirayama teaches that this solution is a common developing solution and allows for an accurate photoresist pattern to be formed.

9. Claims 51-55 and 69-71 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rostalski (U.S. Patent Publication 2003/0174408) in view of Casiday ("Water Hardness: Inorganic Reactions Experiment") and French (U.S. Patent Publication 2004/0175647) as applied to claims 38, 40-47, 57, 59, 63-66 and 74 above, and further in view of Letz (U.S. Patent Publication 2005/0186513).

The teachings of Rostalski, Casiday and French have been discussed in paragraphs 5 and 6 above.

Rostalski, Casiday and French fail to disclose that a fluorine containing compound is dissolved in water, that the fluorine containing compound can be sodium fluoride, potassium fluoride or hydrogen fluoride, and that the concentration of the fluoride ions is greater than 0.01, 0.05, and 0.1 mol/L.

Letz discloses a composition for an immersion lithography liquid comprising saturating a 4-valent element and carbon or silica, with a hydrogen and a halogen, said halogen chosen from fluoride, chloride and bromide (Paragraphs 0016 and 0017), which

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means hydrogen fluoride could be used, as recited in claims 51, 52, 69 and 70 of the present invention.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have used hydrogen fluoride, as suggested by Letz, in the immersion fluid in the processes of Rostalski, Casiday and French because Letz teaches that using this compound allows for a more accurate exposure step of the immersion lithography process. It also would have been obvious to one of ordinary skill in the art to have used the range of concentrations of fluoride ions recited in claims 53-55 and 71 because this concentration determines the pH of the immersion fluid and can be determined by one of ordinary skill in the art without undue experimentation to form the fairly neutral to slightly acidic pH levels recited in claims 40-43 of the present invention.

Response to Arguments

10. Applicant's arguments, filed 12/11/2007, have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of newly found prior art references.

The references, Fukuda, Rostalski and Casiday, have been added to teach an immersion lithography method using water as an immersion fluid and the water having a pH less than 7.

Claims 48, 49, 51-55, 58, 60-62, 67-71, 73 and 75 are rejected for being dependent on rejected independent claims 38 and 63 and due to the prior art references, French, Levinson, Hirayama and Letz, as discussed above.

Conclusion

11. The following non-prior art references are made of record because they are considered pertinent to applicant's disclosure for teaching an immersion fluid having a pH less than 7: EP 1510872, EP 1482372, 2005/0007570 (English equivalent of EP 1482372), 2005/0078286 (English equivalent of EP 1510872), 2006/0072088, 2007/0046915.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRITTANY RAYMOND whose telephone number is (571)272-6545. The examiner can normally be reached on Monday through Friday, 8:30 a.m. - 5:00 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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**/Mark F. Huff/
Supervisory Patent Examiner, Art Unit 1795**